and it will certainly take its place beside his 1947 paper, which it supplements and complements.

As regards method, he has sharpened up his oöid studies, especially by insisting on distinctions between several "species", so that data from different areas may be truly comparable, and each type of oöid can contribute its share. Furthermore, he has sought out new types of information of several kinds, especially by using the orientation of striae on slickensided surfaces and of fibrous crystals growing in fractures during deformation. As regards results, he has provided new evidence for many of his earlier conclusions, for example, that the appearance of cleavage is closely related to increasing body deformation in the rock and that stratigraphic thicknesses can be seriously distorted by such deformation, and he has shown that the South Mountain plan is remarkably consistent over a body of rock 250 km long, 60 km wide, and perhaps 10 km thick—not less than 150,000 cubic km!

Professor Cloos concludes his introduction by remarking that "this study is a reconnaissance and probably points out more problems than it solves," but he has also started us along the road to solving them. His discussion of what happens mechanically when a subspherical oöid is distorted into an ellipsoid shows the complexities that actually underlie the "homogeneous strain" of continuum mechanics; perhaps for this reason there is less quantitative discussion of strain here than in the 1947 paper. The obvious involvement of the Blue Ridge basement in the South Mountain plan leads him into a stimulating discussion of the kinematics of Appalachian deformation and of the necessity to postulate true lateral shortening and to relegate gravity as a motive force to a secondary role. Finally, he points out that the plan affects all rocks from the Precambrian basement to the Silurian and Devonian strata of the Massanutten syncline, and hence he is apparently retreating from the conclusion he had reached in 1964, presumably in large part on the basis of geochronometric dating in the Piedmont, that the Blue Ridge anticlinorium and the South Mountain plan were produced during Ordovician deformation. A serious contradiction is thus posed that future work must resolve, perhaps by showing that the dating is incorrect or is irrelevant to the Blue Ridge or by showing that the deformation affecting the Silurian and Devonian was a later event, which happened to be coaxial with the South Mountain plan. In any case, more work is in order, both in the dating laboratory and in the field.

JOHN RODGERS

Physical Geography—A Systems Approach; by RICHARD J. CHORLEY and BARBARA A. KENNEDY. P. xxi, 370 figs., tables, references, index. London, 1971 (Prentice-Hall Internat., Inc. 2 pounds; cloth 4.25 pounds).—Ten years ago Richard J. Chorley introduced a wide audience to the advantages of applying general systems theory to geomorphology. The present volume is an amplification, elaboration, and extension of that theme. It presents a discussion of systems and their application to examples from physical geography. The structure of the interpretation of physical-geographic phenomena stands in the foreground, rather than the phenomena themselves.

The authors distinguish four different levels of systems: (1) "Morphological" systems, basically the set of interrelated parameters that characterize a "recognizable operational part of physical reality" (for example, the slope, surface conditions, and granulometric properties of a beach). (2) "Cascading" systems, in which mass or energy is transmitted from one subsystem to the next locationally adjacent subsystem. The transfer of rock debris from its point of origin downslope and downstream to its point of eventual deposition, the transfer of solar energy among the components of the terrestrial environment, or the hydrological cycle would be examples of this type. (3) "Process-response" systems, which "are formed by the intersection of morphological and cascading systems" in other words, the combined interaction of form, material, and process. (4) "Control" systems, that is systems that affect crucial parameters of process-response systems and thus modify the latter. The authors understand by this mainly the interference created by man's activities as a landscape-changing agent. The analytical discussion of each of these four system types and their application to examples from geomorphology, hydrology, and climatology comprise the essence of this book. Interspersed are chapters dealing with aspects common to several system types, such as the properties of system input and output, different kinds of equilibrium, and the mechanisms of changes in systems. Along the way, some of the quantitative methods that have found application in physical geography (for example, regression analysis, analysis of variance, probability distribution of events, trend surface and Fourier analysis) are briefly explained.

Whether the four system levels are really as clearly distinguishable as the authors believe remains open to further discussion. It seemed to this reviewer that some examples given for morphological systems could equally well serve as examples for process-response systems, and vice versa. Also, any one of two or more intersecting systems can act as a control system for the others, and often does, as in the case of hydrologic, tectonic, or vegetational "control" of slope development. The question whether a change is initiated by man or by natural events is of no importance to the function of the control system. Perhaps one could distinguish local (or interaction) systems and spatially extended (cascading or transmission) systems, but even then the distinction is mainly a matter of scale. In effect, all these systems are governed by the entering and leaving of energy or of matter and are merely arbitrarily segregated parts of a more universal energy and mass-balance system which can be conveniently thought of as consisting of a nested hierarchy of subsystems.

The overall merit of this book appears twofold. First, it offers a manageable structure for the comprehensive study of the interrelated phenomena that make up the physical environment; this structure can be applied at any scale, from global balance systems to the weathering of a single mineral grain. Second, it is bound to stimulate constructive methodological discussion which could further improve our understanding of both the subject matter of physical geography and the application of systems theory in general. The reader cannot help but rethink (and test) his own interpretation in the light of what the authors propose. Because they focus more upon the systems structure than physical geography, their work should be of interest not only to geographers, but to anyone else working in the earth sciences as well.

FRANK AHNERT

Evolution of the Earth; by ROBERT H. DOTT, JR., and ROGER L. BATTEN. P. xiii, 649, 577 illus., 4 color pls. New York, 1971 (McGraw-Hill Book Company, $13.50).—Occasionally an exceptional elementary text book appears that stands head-and-shoulders above others in its field. In my opinion, *Evolution of the Earth* is such a book. Dott and Batten may be newcomers to the textbook "battlefield", but they have entered the fray armed with plenty of ammunition. It may be a year or two before their book nudges aside the tried and tested traditional leaders among textbooks on historical geology, but I predict that they will top the list before very long. The reasons are many, but they all boil down to just a few words: the authors have put together a fascinating book that is alive and original. The text is fresh, lively, and enthusiastic; the topics have been carefully chosen to present concepts and promote understanding of principles rather than encyclopedic masses of data—and these most often are presented in a "human" context (either current or historical); and the pages are literally crammed with hundreds (577 to be exact) of well-planned and clearly executed illustrations (nearly all of them new) that beautifully supplement the text.

But most important of all is the tenor of this book. It is not a book about "dead" ancient history. It is a well written book about the living Earth, and better than most other elementary texts that I know of, this book makes it clear that the living (or is it now the dying?) Earth of today is the product of dynamic processes—the never-ending interaction of energy and earth substances over eons of time. Indeed the authors have done much more than compile an elementary synthesis of our current understanding of the Earth's history and those processes that have moulded our planet. They have successfully woven together a sketch of the maturing science of geology, a vivid picture of the evolving planet Earth, and the growth of the North American continent, liberally laced with concise explanations of fundamental concepts, theories, and processes. But the authors' philosophy says it better than I can describe it, and I quote from their Preface:

"In the tradition of liberal education we believe that introductions to sciences should be primarily conceptual rather than informational. Students deserve introductions that reveal the logical framework of a discipline, show relations of that discipline to the totality of man's knowledge, and give them some idea of what it is like to be a participant in